

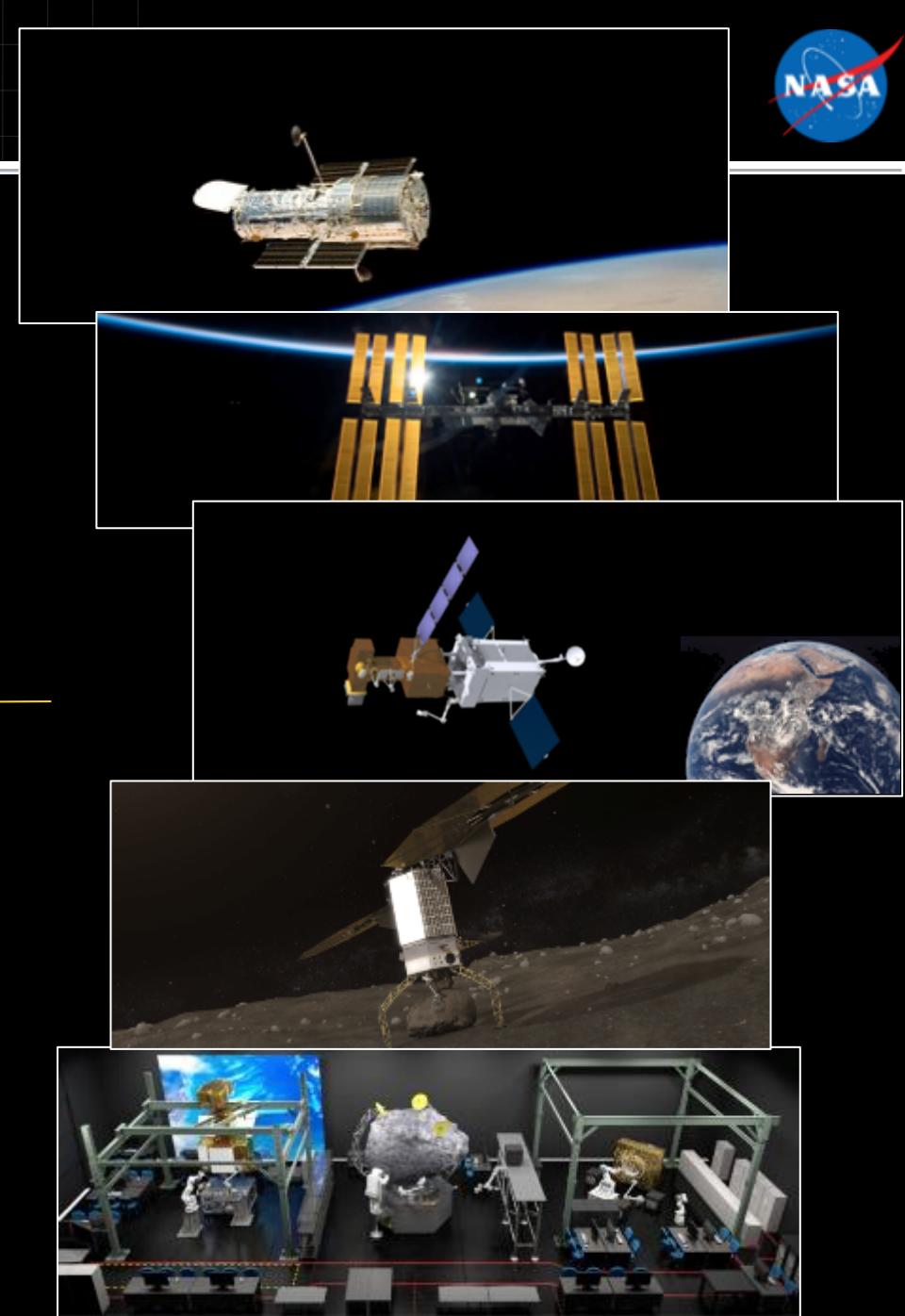
Reinvigorating the Entrepreneurial Spirit of NASA
Abstract
Maniac Talk/GSFC

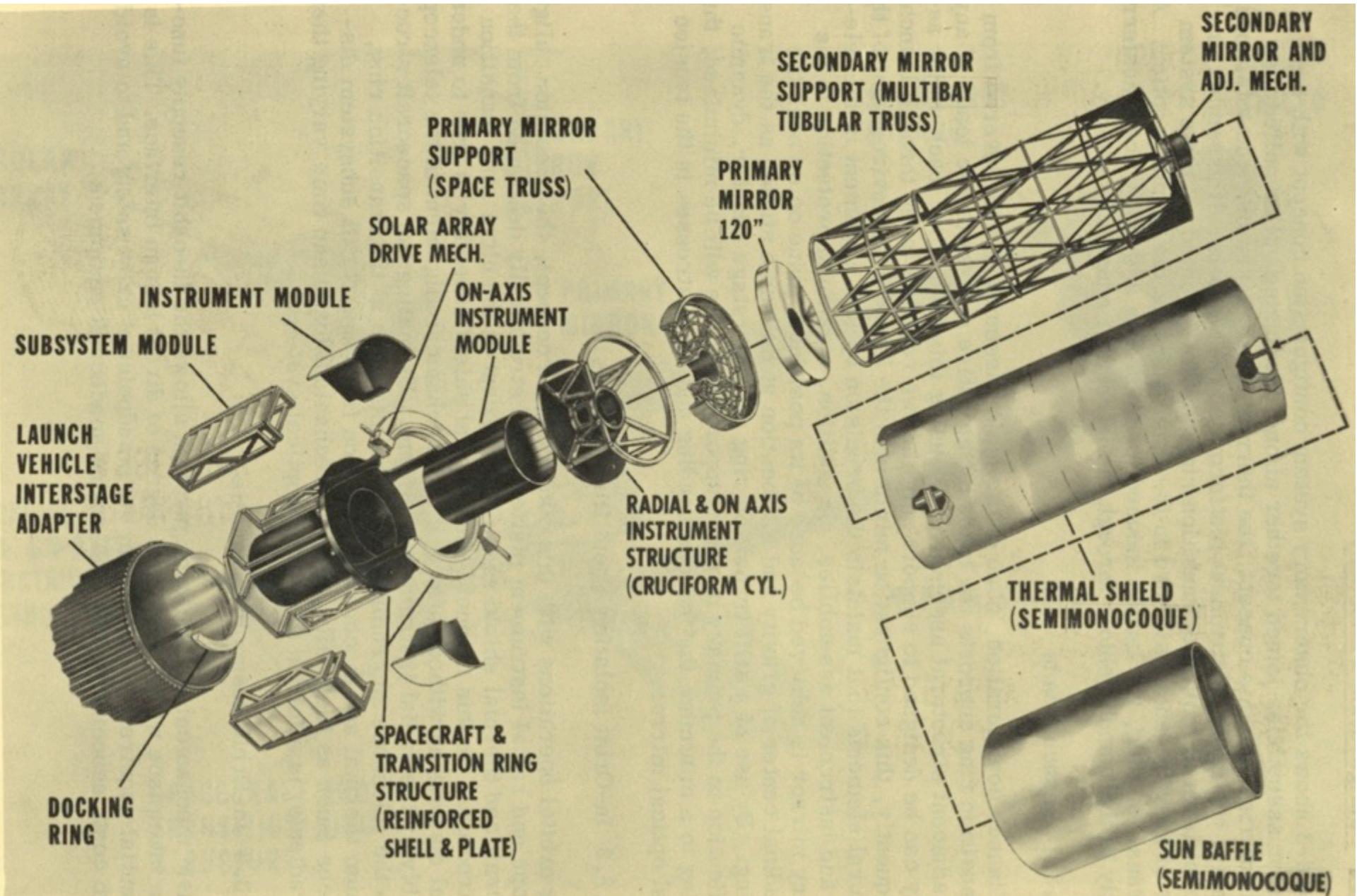
This talk gives a rundown of a career in servicing and looks to the future of servicing and scientific missions working together. The talk attempts to reinvigorate the old NASA entrepreneurial spirit.

Reinvigorating the Entrepreneurial Spirit of NASA

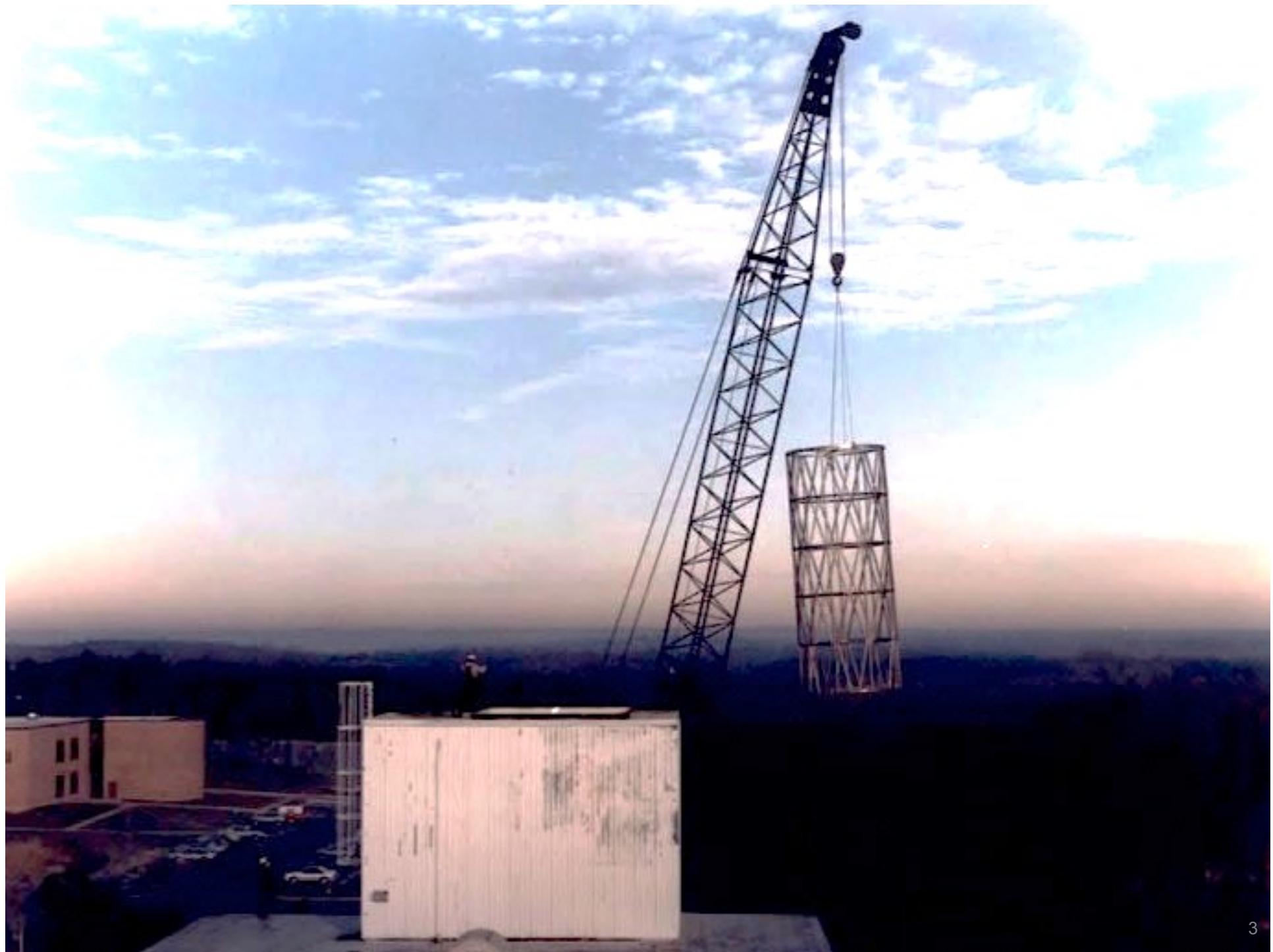
Maniac Talk
August 28, 2015

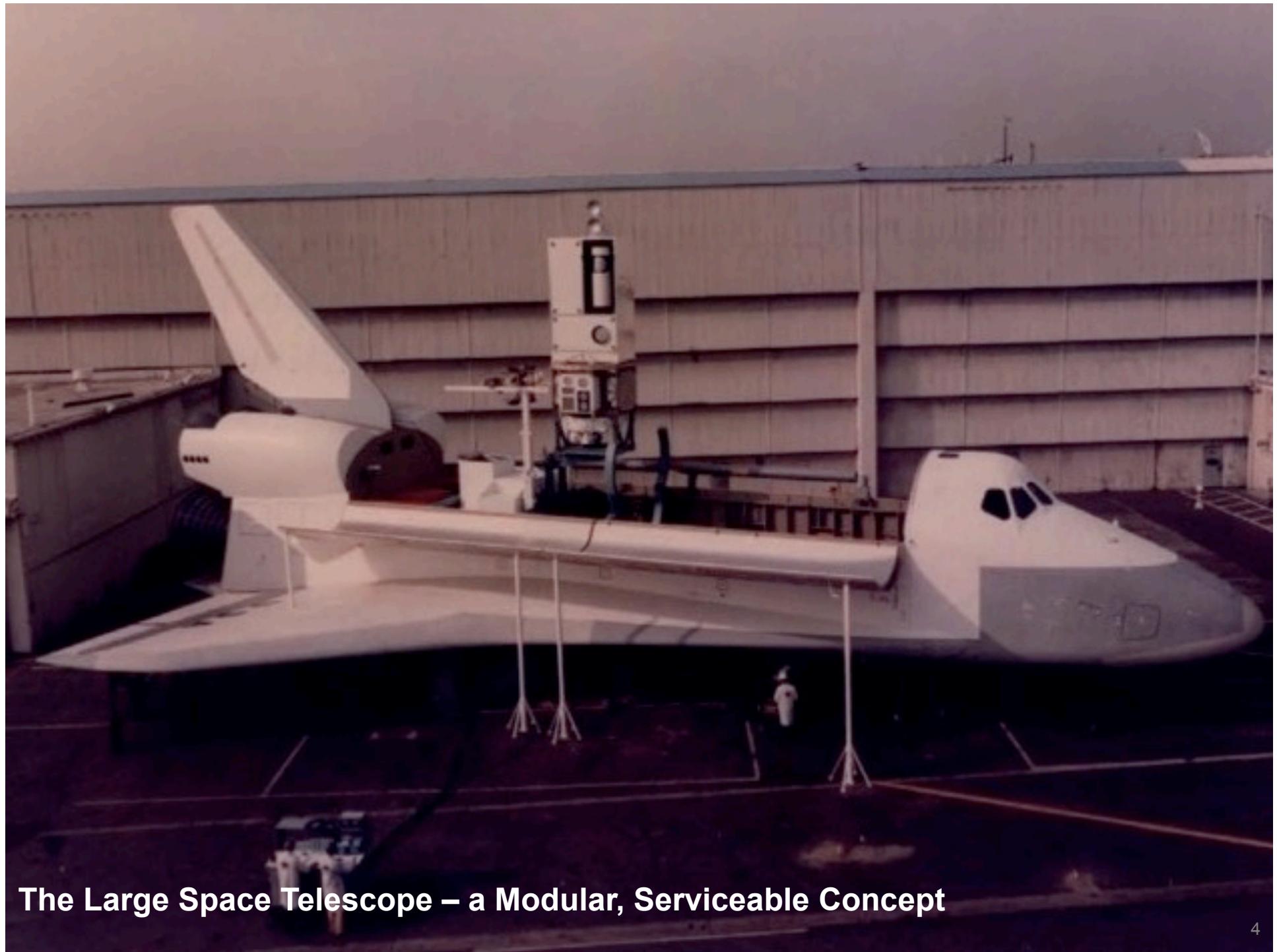
Frank Cepollina
Associate Director
Satellite Servicing Capabilities Office
<http://ssco.gsfc.nasa.gov>





The Large Space Telescope – a Modular, Serviceable Concept





The Large Space Telescope – a Modular, Serviceable Concept



Solar Max 1984



**Westar 6 & Palapa 2B
1984**



Syncom IV 1985



GRO 1991

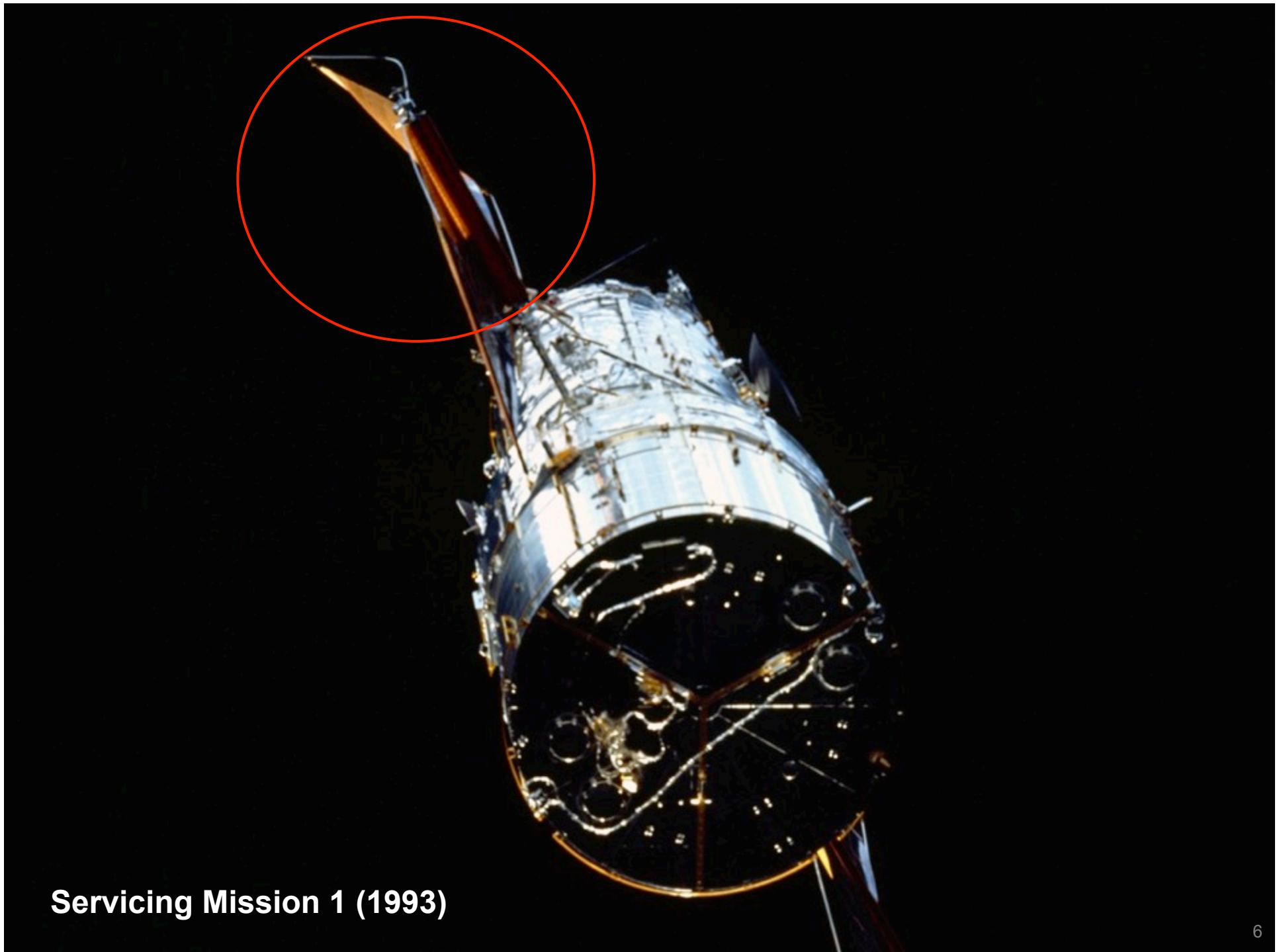


Intelsat 603 1992



**Hubble Servicing
Missions
1993 - 2009**

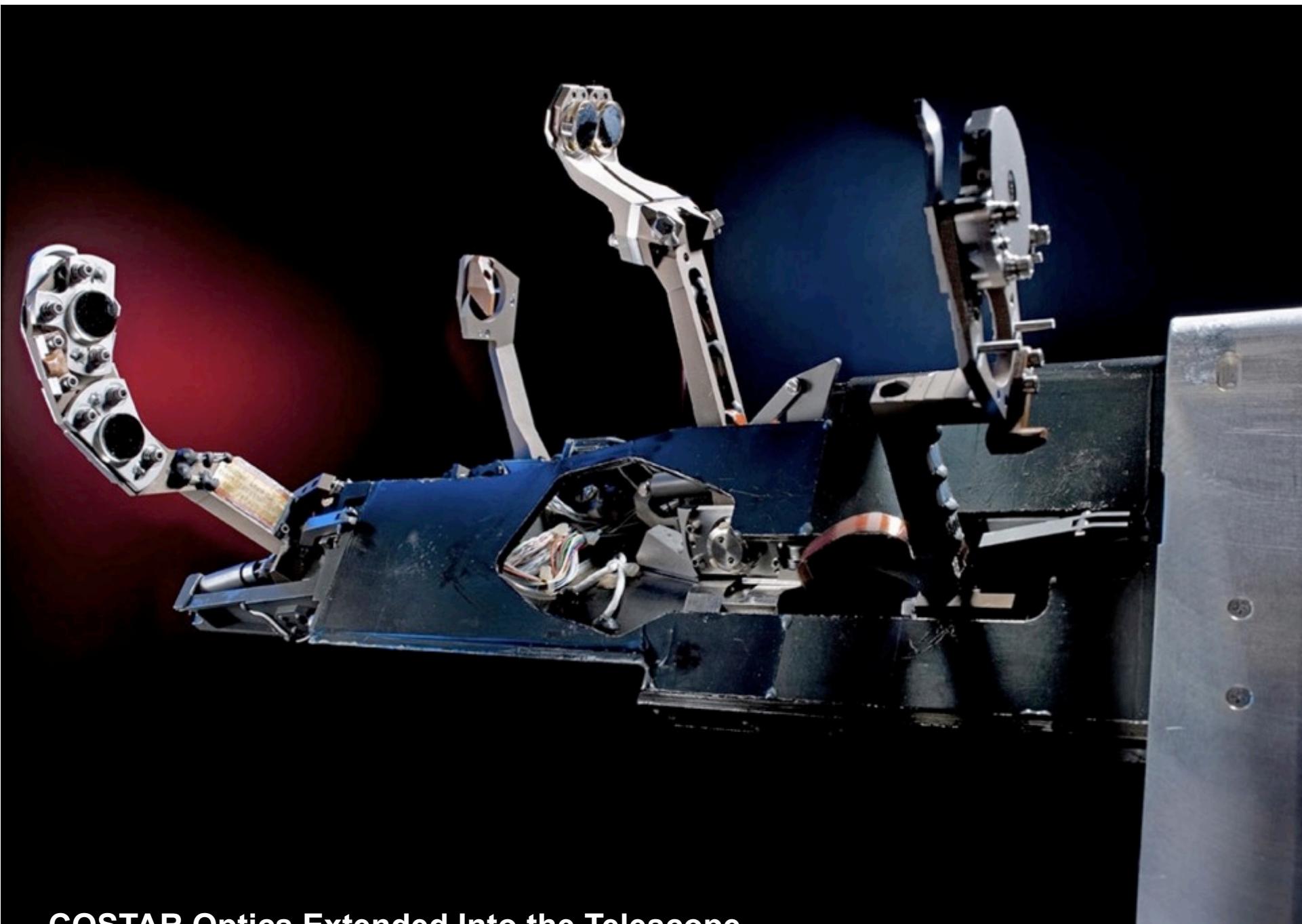
**Rich history of on-orbit
satellite servicing.**



Servicing Mission 1 (1993)



Installing Corrective Optics Space Telescope Axial Replacement (COSTAR)



COSTAR Optics Extended Into the Telescope

Eric Long/NASM, copyright Smithsonian Institution



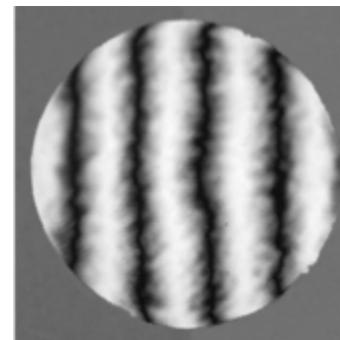
The Human Impact of the Hubble Servicing Missions

*Focused on Innovation and Technology,
Driven by Our Desire to Explore*

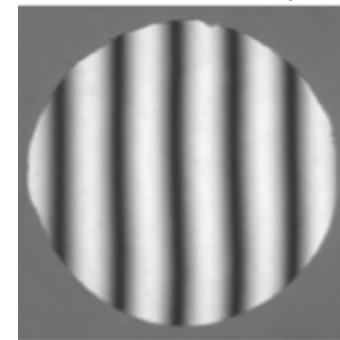


COSTAR Optics

Optical Fringe Pattern:
Demonstrates line accuracy and feature size



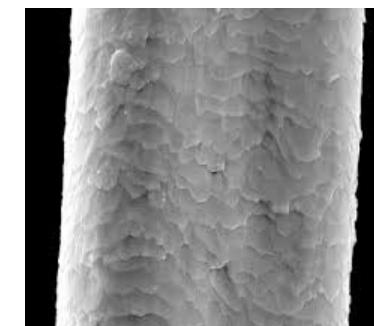
1990
7/10th hair



1992
1/300th hair



2015
1/1000th hair



← →
The average
human hair is ~70
microns across

Photolithography

COSTAR corrective optics represent a great improvement in photolithography.

Photolithography is a key process for improving transistor density on a chip.

Apollo Guidance Unit
(4 Kb RAM, 27 Kb memory)



iPhone 6
(1 Gb RAM, 16 Gb memory)



Processing Power:
1 iPhone 6 = **260,000** Apollo
Guidance Units

Memory:
1 iPhone 6 = **620,000** Apollo
Guidance Units

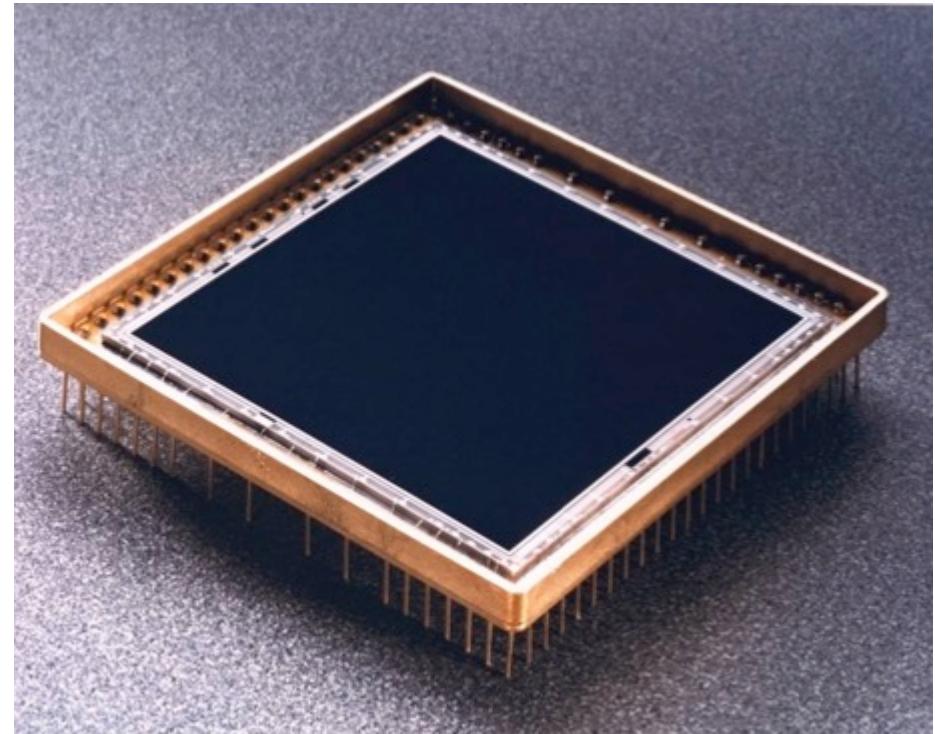
7 Memory Cards
can hold 1 year
of Hubble data
(1.825 TB)

Processing Power and Memory Storage

COSTAR developed better optics that improved Photolithography and therefore allowed for greater transistor density and storage capacity in a smaller volume.

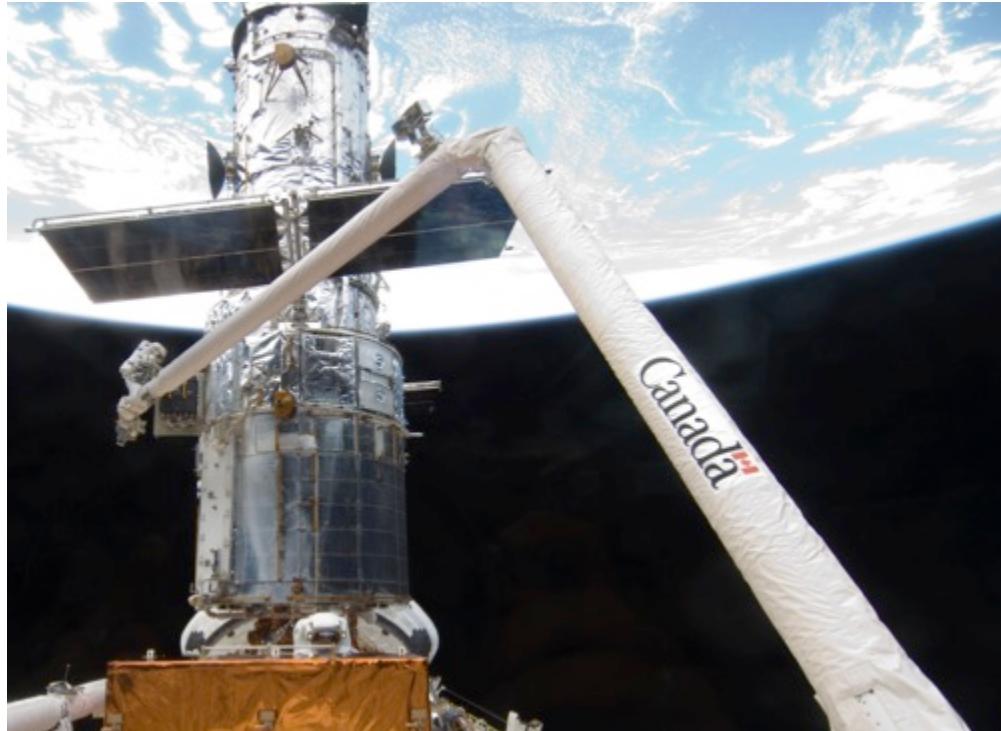


**Stereotactic Breast Biopsy System
replaces surgery**



Charge-coupled Device

A Technological Push to a Medical Reality

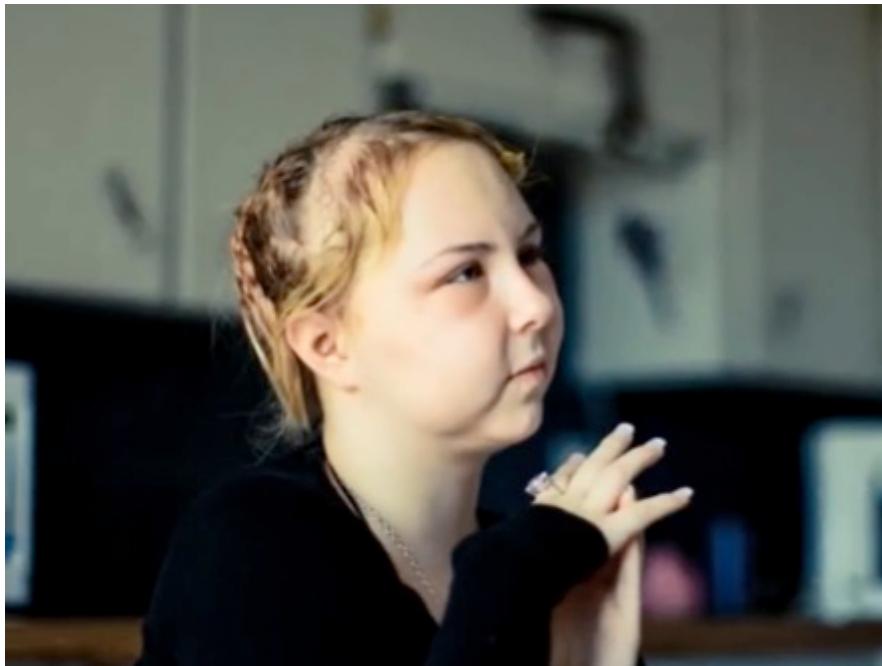


Robotic Technology



da Vinci Surgical System

Robotic Surgery



Before

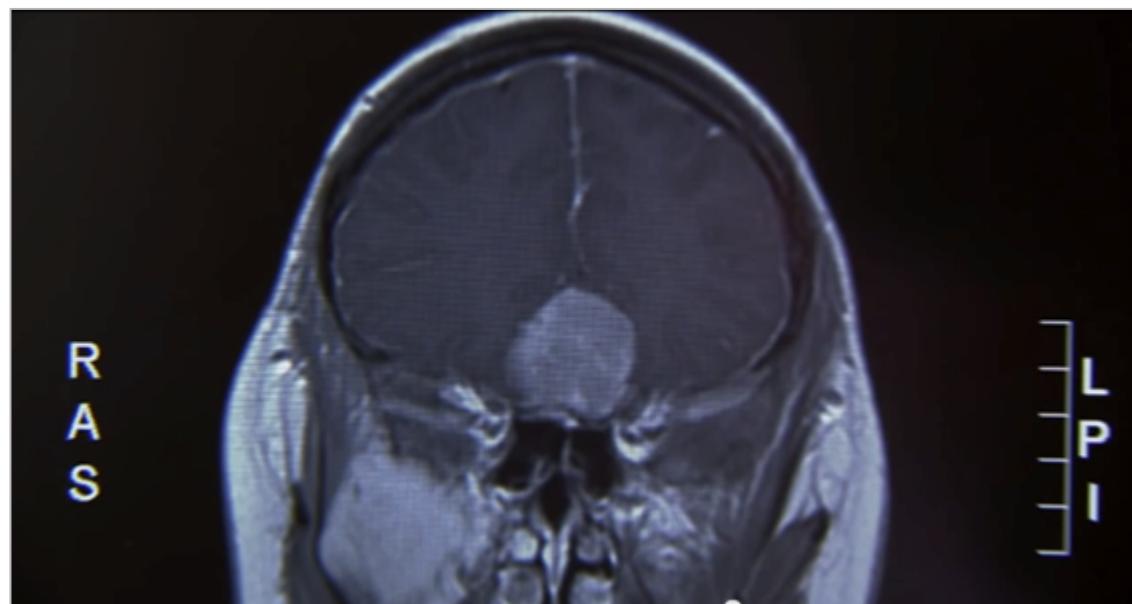


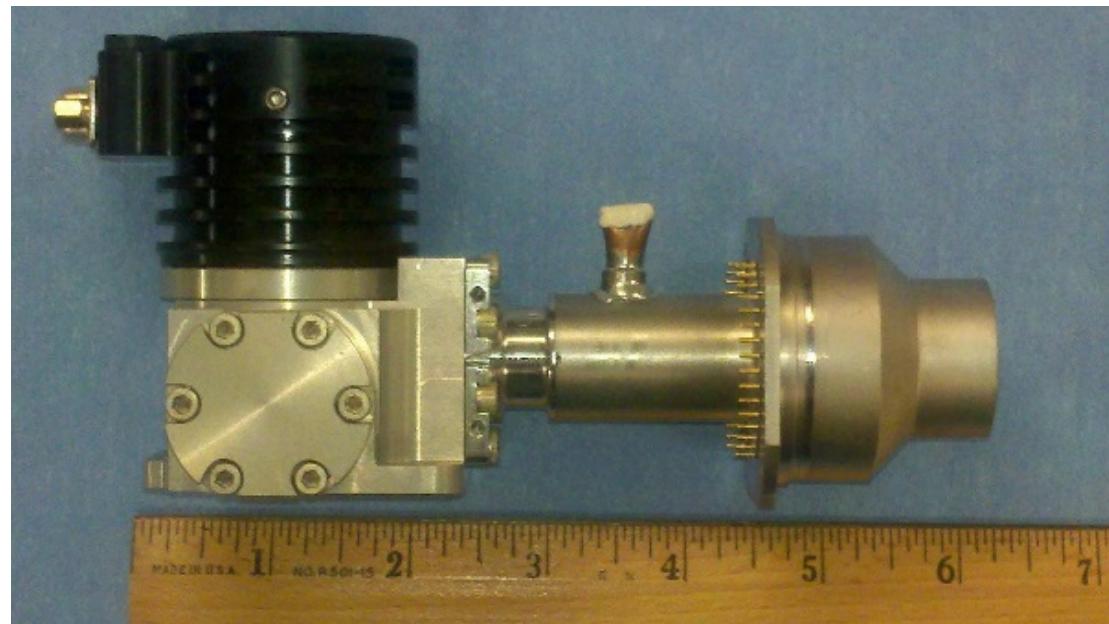
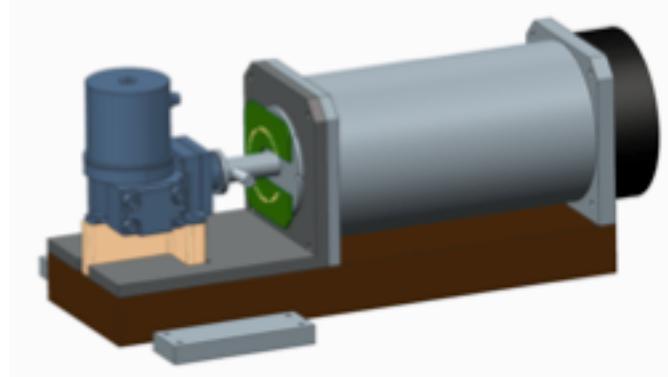
After

Robotic Surgery



Visible Heart Laboratory,
University of Minnesota





Compact Thermal Imager

Where Are We Going From Here?

